A preliminary review of the genus *Oxystegus* in Britain and Ireland

Following a detailed study of *Oxystegus* in Europe, **Tom Blockeel** illuminates the current taxonomic views for British bryologists

The genus *Oxystegus* is not recognised in the current edition of the Census Catalogue of British and Irish bryophytes (Hill *et al.*, 2008). It was, however, included in the first edition of A.J.E. Smith's Moss Flora (Smith, 1978) to accommodate *Oxystegus tenuirostris* and the closely allied *O. hibernicus*, and a third species, *O. sinuosus*, which has a superficial similarity to *O. tenuirostris* in its fragile, notched leaves. Hill (1979) showed that *O. sinuosus* is closed allied to *Didymodon* (at that time included within *Barbula*) and this conclusion has been widely followed by subsequent authors. In the second edition of his Flora, Smith (2004) abandoned *Oxystegus* and included *O. tenuirostris* and *O. hibernicus* in *Trichostomum* along with *T. crispulum* and *T. brachydontium*.

There is now good evidence from molecular studies that *Oxystegus* is genetically distinct from *Trichostomum* (Werner, Ros & Grundmann, 2005). Recently Köckinger, Werner & Ros (2010) have published a detailed study of the European species. They include the hyper-oceanic moss *Paraleptodontium recurvifolium* in the genus, along with *O. hibernicus* and *O. tenuirostris* (the latter with two varieties, var. *tenuirostris* and var. *holtii*). In addition they recognise two further species, *O. daldinianus* (originally described from the southern Alps) and a new species, *O. minor*. All five of the accepted species occur in Britain, and four of them in Ireland. This note reviews the differences between the species, as described by Köckinger *et al.* (2010), and documents what is currently known about their distribution within these islands.

Oxystegus recurvifolius is well known (as *Paraleptodontium recurvifolium*) in the oceanic west of Britain and Ireland and is clearly separated from the other *Oxystegus* species by its leaves with coarsely toothed margins and a strongly defined border of thick-walled, non-papillose cells. It is rarely, if ever, mis-identified and is not considered further in this note.

The four remaining species of the genus fall into two pairs:

O. hibernicus and ***O. minor***: mature leaves 1.5-4 mm long; leaf margins entire (not toothed or notched), not undulate; stems slender, in cross-section with rarely more than 20 cylinder cells, which are (25–)30–40 µm wide and thin-walled; central strand lacking.

O. tenuirostris and ***O. daldinianus***: mature leaves 3-9 mm long; leaf margins irregularly notched, sometimes toothed towards the apex, often undulate (like *Tortella tortuosa*);

△ *Oxystegus daldinianus,* in a rocky ravine at Cwm Idwal, photograped during the IAB field excursion to North Wales, see page 79. Jo Wilbraham

stems thicker, in cross-section with 25-80 cylinder cells, 15–35(–40) µm wide and tending to be thick-walled; central strand sometimes present.

The stems in *Oxystegus* species have an outer row of thin-walled cells (a hyalodermis) and a cortex of several rows of small thick-walled cells which give the stem rigidity. Inside the cortex is the internal cylinder which consists of large cells with thin or sometimes thickened walls. Some species may also have a central strand (down the middle of the stem), consisting of small very thin-walled cells. In examining specimens, I have found that the stem morphology is more variable than stated by Köckinger *et al.* (2010). I have seen specimens of *O. hibernicus* with ca 30 cylinder cells, the outer cells of the cylinder being rather thick-walled, and conversely plants clearly belonging to the *tenuirostris/daldinianus* group with only around 20 cylinder cells. There is no sharp discontinuity using this character alone. Fortunately, typical specimens of *O. hibernicus* are readily recognised by their expanded leaf bases.

O. hibernicus and *O. minor*

These two species are small to medium-sized in stature, with relatively short, not very fragile leaves, and when moist the leaves are straight, without undulate margins and lacking teeth and notches (or almost so, though the margin may be crenulate from projecting cells). The stem section can be a useful additional character in separating them from small forms of *O. tenuirostris* but, as noted above, there is more overlap than suggested by Köckinger *et al.* (2010).

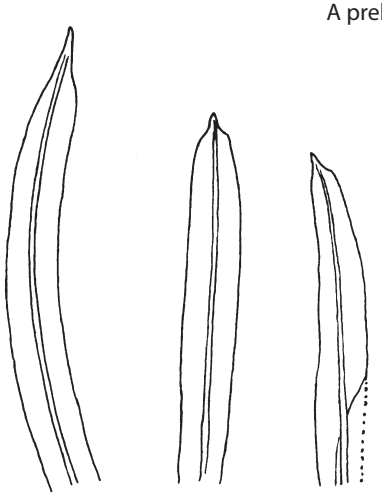
The distinguishing characters for *O. hibernicus* and *O. minor* given by Köckinger *et al.* (2010) are:

Basal part of leaf distinctly expanded to form a wide sheath, and with ± distinct shoulders at the transition to the upper part; central cells of sheath elongate, 40-80 µm long, thin-walled and somewhat inflated, rather abruptly differentiated, separated from the upper cells by a zone of thick-walled, hyaline cells.

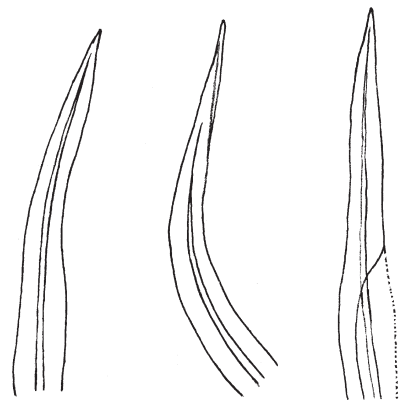
O. hibernicus

Basal part of leaf hardly expanded, without shoulders; central cells of sheath shortly rectangular, about 40 µm long, often rather thick-walled, usually with a gradual transition to quadrate cells of upper lamina. *O. minor*

Bryologists familiar with *O. hibernicus* in Britain and Ireland are aware that its most distinctive morphological character, its expanded leaf base,



△Fig. 1: Leaf shape of typical *O. daldinianus* (from Blockeel 40/477). Tom Blockeel



△Fig. 2: Leaf shape of *O. tenuirostris* var. *holtii* (from Blockeel 40/478). Tom Blockeel

is variable and specimens are often encountered in which the base is hardly wider than the upper lamina. At first sight *O. minor* appears to offer a neat solution to this problem. However Köckinger *et al.* (2010) analysed only a very small number of specimens of *O. minor* (from a few places in Austria and southern Scotland) and my own examination of specimens of this group – including specimens from southern Scotland, where *O. hibernicus* is very rare - indicates that the characters intergrade to such an extent that many specimens cannot be allocated to one or other species on morphological grounds. The original voucher of *O. hibernicus* from Moffatdale (VC 72: Carrifran, R. Hall, Aug. 1950) has leaves with distinctly expanded bases, whereas later specimens from the same locality, including material of *O. minor* sequenced by Köckinger *et al.* (2010), do not show this character. Further study, including molecular sequencing of a wide range of British and Irish material, is required to verify the status and morphological limits of *O. minor*.

O. tenuirostris and *O. daldinianus*

These two species are smallish to robust in stature (to around 5 cm tall) and they usually have longer leaves than *O. hibernicus* and *O. minor*: in *O. tenuirostris* the comal (apical) leaves may reach 9 mm in length. When moist the leaves are often flexuose and frequently have undulate margins (and may therefore resemble lax forms of *Tortella tortuosa*). They are fragile and often broken, irregularly notched along the margins and sometimes have distinct teeth in the middle and upper part of the leaf. The stems are relatively stout, and the central cylinder on well-developed shoots consists of 25-80 cells, though the cells are slightly smaller than in *O. hibernicus* and *O. minor*, and they often have somewhat thickened walls. A stem central strand may be present (but only in some specimens of *O. tenuirostris*, apparently never in *O. daldinianus*).

O. daldinianus was described originally from Locarno in Switzerland as a variety of *Didymodon cylindricus* (=*D. insulanus*), and it is also known from Austria, Norway, and Yunnan in China. Dixon was aware of it and recognised it as a variety of *O. tenuirostris* (*Trichostomum tenuirostre*) in his Student's Handbook of British Mosses (Dixon, 1896). However he placed too much emphasis on the nature of the marginal leaf cells as a diagnostic character, and the variety fell into obscurity during the 20th century.

According to Köckinger *et al.* (2010), *O. tenuirostris* and *O. daldinianus* are separated as follows:

△Fig. 3: *O. daldinianus*, showing stereid cells on dorsal surface of nerve (from Blockeel 40/477). T. Blockeel

Leaf lamina typically ligulate (parallel-sided) and suddenly narrowed at apex to a ± cuspidate point (Fig. 1, but some leaves may be present with a lanceolate shape and gradually tapered margins); sheath often narrower than upper lamina; margins minutely and remotely toothed; cells on the dorsal surface of the nerve below apex elongate and very thick-walled, smooth throughout; stem without a central strand. *O. daldinianus*

Leaf lamina typically linear-lanceolate, gradually narrowed to apex from mid-leaf or below; sheath often somewhat wider than upper lamina, margins frequently notched in upper part of leaf (more rarely toothed or entire); cells on the dorsal surface of the nerve below apex mostly quadrate to shortly rectangular, not very thick-walled and often papillose; stem sometimes with a central strand. *O. tenuirostris*

These species are rather variable and the morphological characters intergrade to some extent. Typical leaf shapes are shown in Figs. 1 and 2 from collections made in Langdale, Westmorland, in 2011, but the overall picture is more complicated. The parallel-sided shape of the leaves in *O. daldinianus* is a very important diagnostic character, but intermediates occur in which the leaves are relatively broad, slightly tapered along the main part of the lamina, and rather abruptly narrowed to the apex. Conversely *O. tenuirostris* var. *holtii* may have weakly tapered leaves with a relatively broad shape. Even on stems of 'good' *O. daldinianus*, there may be some leaves with the margins tapered from below mid-leaf to the apex, and the comal leaves are sometimes longer and narrower than the lower leaves. The cuspidate apex of *O. daldinianus* is often more apparent *in situ* than under a cover-slip, as the tip is often channelled, exaggerating the cuspidate shape.

Köckinger *et al.* (2010) emphasise the shape of the cells on the dorsal side of the nerve just below the leaf apex. However, the elongate to linear, very thick-walled cells of *O. daldinianus* are difficult to observe in surface view because the lumen is indistinct (beware confusion with the guide cells, which may come into view if the lens is focussed below the nerve surface). I have found it useful to cut a section of the nerve near (approx 1/10th from) the leaf apex. The nerve section of specimens of the *daldinianus* type usually has an undifferentiated (or poorly differentiated) dorsal layer, i.e. with stereid cells exposed on the dorsal surface (Fig. 3), whereas typical *O. tenuirostris* shows a differentiated dorsal layer of sub-stereid cells with wider lumens (Fig. 4).

Specimens in which the leaf shape is ambiguous may or may not have a differentiated outer layer on the dorsal surface of the nerve.

△Fig. 4: *O. tenuirostris*, showing differentiated sub-stereid cells on dorsal surface of nerve (from Blockeel 40/478). T. Blockeel

Further molecular sequencing will be necessary to establish the morphological boundaries of the species. At present there are some specimens that I am not able to name with confidence; however such specimens are in a small minority.

The presence of a stem central strand is of limited usefulness in separating the two species, since it is most often present in *O. tenuirostris* var. *tenuirostris*, which is more clearly distinct from *O. daldinianus* in leaf shape and nerve structure than var. *holtii*.

O. tenuirostris var. *tenuirostris* and var. *holtii*

Var. *holtii* is adapted to wetter habitats than var. *tenuirostris*, and it often grows on wet rocks or close to running water. It tends to become blackish in the older parts of the shoots, it has a stouter nerve and smaller cells than var. *tenuirostris*, and there is a tendency for the leaves to break along the nerve rather than across the lamina. In detail the differences are:

Plants yellow to dark green. Central strand of stem usually present. Leaves increasing in length along the stem and formal comal tufts with leaves up to 9 mm long, readily breaking across the lamina (less frequently along the nerve), apex sharply pointed; upper leaf margins mostly notched (more rarely toothed); sheath often longer than wide, not strongly coloured (more rarely yellowish); nerve at leaf base rarely wider than 100 µm (–120 µm), in cross-section reniform at mid-leaf, rarely with more than 4 guide cells; cells on the dorsal surface below apex mostly quadrate and papillose; cells of sheath often reaching 100 µm or more in length; upper lamina cells 8–16 µm, coarsely papillose.

var. *tenuirostris*

Older parts of plants often blackish. Central strand of stem often absent. Leaves hardly forming distinct comal tufts, up to 6 mm long, normally breaking along the nerve, apex mostly bluntly pointed or even narrowly rounded; upper leaf margins weakly notched to entire; sheath often wider than long, yellowish; nerve at leaf base often wider than 100 µm (to 180 µm), cross-section in mid-leaf tending toward circular, with 4–8 guide cells, cells on the dorsal surface below apex mostly short-rectangular, at most faintly papillose; cells of sheath rarely longer than 80 µm; upper lamina cells 4–10 µm, finely papillose.

var. *holtii*

It is unwise to rely on any one individual character. Cell size is important but is variable, even on individual shoots, and some specimens have cells of an intermediate size, ca 10–12 µm wide. I have seen rather few specimens of var. *tenuirostris*, but they are marked by narrow,

sharply pointed leaf apices, mostly with short, quadrate cells on the dorsal surface of the nerve near the apex.

Conclusions

O. recurvifolius (*Paraleptodontium recurvifolium*) is distinct and well characterised. The other British and Irish taxa of *Oxystegus* exhibit great morphological variation. *O. minor* requires further study before it can be reliably recorded. *O. daldinianus* and the varieties of *O. tenuirostris* can be distinguished in most cases and I would welcome further specimens to establish their detailed distributions and the extent to which apparent intermediates occur.

Distribution

The following notes on distribution are based on the specimens cited by Köckinger *et al*. (2010) and additional specimens examined by myself. I have not attempted a complete revision of British and Irish material. In the citations, the vice-county number is printed in bold type before the remaining details of the record. I have not cited specimens considered intermediate.

O. minor. For reference, the specimens referred to this species by Köckinger et al. (2010) are cited here.
72: wet flushed slope on NE-facing slope, 550m, above Loch Skeen, Mid Craig, Moffat Hills, NT165165, G.P. Rothero & H.L.K. Whitehouse, 3 Aug 1993, det. R.M. Ros & H. Köckinger (BBSUK); **78**: wooded ravine, on stones in small tributary, 320m, Talla Linns, NT137203, D.G. Long, 5 May 2000, det. R.M. Ros & H. Köckinger (BBSUK).

O. daldinianus. It is likely that this species will prove to have an oceanic distribution in Britain and Ireland. Current records suggest that it often occurs as lax (often robust) patches on wet rock ledges on crags and in ravines.
44: large patches on ± base-enriched rock outcrops in ravine, Cothi Gorge, SN740478, S.D.S. Bosanquet, 6 Oct 2011; **44**: on rock outcrop by waterfall in ravine, Gwenffrwd Gorge, SN740478, S.D.S. Bosanquet, 27 Sep 2011; **44**: rocks by stream, Gwenffrwd RSPB, SN741476, S.D.S. Bosanquet & G.S. Motley, 10 Dec 2003; **48**: humus on rocks at top of waterfall, Cwm Cadian, Corris, SH74960544, S.D.S. Bosanquet, 25 Jan 2011; **49**: rocks by stream, Coed Cae Huddygl, Bettws y Coed, SH588580, S.D.S. Bosanquet, 23 May 2011; **69**: on wet rocks in steep gill, Dungeon Ghyll, Langdale, NY2806, T.L. Blockeel 40/477, 22 Sep 2011; **70**: on wet rock ledge, Bowscale Tarn, NY3331, T.L. Blockeel 41/274, 1 Apr 2012; **76**: on rock wall by waterfall, ca 250m, Raithburn, Muirshiel, NS3063, T.L. Blockeel 32/738, 14 Aug 2003; **98**: damp shaded rock face, Allt Coire Gabhail, Glencoe, NN15, S.D.S. Bosanquet, 4 Aug 2011; **106**: on wet rocks on crag, east face of Creag an Duine, Coire Mor, Strath Mulzie, NH2987, T.L. Blockeel 21/233, 27 Jul 1992; **H1**: in wet rock crevice, Carrauntoohil, Cummeenlour, on the ascent to L. Cummeenoughter, V8084, T.L. Blockeel 36/513, 24 Jul 2007; **H3**: in wet rock crevice near base of crag, ca 310m, at the head of the valley, Gougane Barra, W069649, T.L. Blockeel 31/330, 11 Aug 2002; **H6**: on wet rock in gully, ca 400m, SW corner of corrie, Coumshingaun, Comeragh Mountains, S3210, T.L. Blockeel 28/287, 12 Aug 1999; **H20**: in hollow among boulders on steep north-facing slope, Glendalough, west of the Upper Lake, T0896, T.L. Blockeel 41/382, 9 Sep 2012; **H27**: on wet rock face, north-facing rocky ravine, 120 m, Srahalloe, north slope of Devil's Mother, L91556489, D.G. Long 36818, 10 Jul 2007, det. R.M. Ros (E); **H27**: on N-facing cliff ledge, 335 m, W ridge of Mweelrea, L7766, D.G. Long 14497, 14 Aug 1987, det. R.M. Ros (E); **H27**: in wet rock crevice on crag, northern corrie of Corslieve, Nephin Beg range, F9212, T.L. Blockeel 41/430, 4 Jul 2012.

O. tenuirostris. The distribution of the species can be accepted as it stands. Var. *holtii* is evidently the commoner of the two varieties in Britain and Ireland. The following records have been confirmed.

O. tenuirostris* var. *tenuirostris: **77**: base-rich sandstone rock ledge on small rock face, W bank of Medwin Water above Medwinhead, NT087518, D.G. Long, 20 Apr 1975 (E); **81**: damp rock face by moorland stream (on silurian rock), Whalplaw Burn, above Carfraemill, Lauderdale, NT541549, D.G. Long 2177, 18 Mar 1973 (E); **81**: on shady wet rock face, wooded river bank with *Salix* and *Alnus*, 130 m, Wild Wood, Edin's Hall, Whitadder Water, NT77196039, D.G. Long & M. Flagmeier 36559, 14 Mar 2007 (E); **104**: on damp calcareous rock ledge, steep rocky hillside, 495 m, east coire of Sron an t-Saighdeir, Rum, NM32709885, D.G. Long 33254, 27 Jun 2004, det. R.M. Ros (E).

O. tenuirostris* var. *holtii: 3: damp rocks near R. Plym, Dewerstone Wood, Goodameary, SX5363, F. Rose & R.C. Stern, 18 Oct 1990, det. R.M. Ros (BBSUK); **44**: rocks by stream running down side of ravine, 240m, Cothi Gorge, SN718466, S.D.S. Bosanquet, 6 Oct 2011; **57**: on wet grit boulder on bank of stream, R. Ashop, Woodlands, SK1289, T.L. Blockeel 40/471, 15 Sep 2011; **57**: on stone by small stream by moorland edge, under trees, 310m, Grindsbrook, Edale, SK1186, T.L. Blockeel 39/393, 9 Sep 2010; **59 in ()**: Bamford Wood, SD81, G A. Holt, Apr 1883 (MANCH); **63**: grit stone by stream, Wharnecliffe Woods, SK3194, T.L. Blockeel, Dec 1979; **63**: on wet grit rock by stream in wooded clough, Raynor Clough, More Hall Reservoir, SK2795, T.L. Blockeel 23/022, Feb 1994; **64**: on stone by streamlet, Dobpark Wood, Washburn Valley, SE1850, T.L. Blockeel 40/491, 15 Oct 2011; **69**: on wet rocks in gill, Crinkle Gill, Langdale, NY2605, T.L. Blockeel 40/478, 23 Sep 2011; **71**: On moist rock face at edge of stream, Laxey Glen, SC4284, T.L. Blockeel 29/411, 4 Aug 2000; **71**: on wet slate rocks, Glen Helen, SC3084, T.L. Blockeel 38/282, 19 Aug 2009; **H2 in ()**: Torc Glen, Killarney, [ca V9684], D.A. Jones, S.J. Owen & J.B. Duncan, Aug 1906 (E); **H8**: rocks in stream, Carrigeen, R880188, S.D.S. Bosanquet & C.D. Preston, 20 Feb 2012; **H27**: on rock by stream, rocky mountain stream, 255 m, Sryhaunaniriska valley, Mweelrea, L80416656, D.G. Long 32017, 4 Jul 2003, det. R.M. Ros (E); **H38**: in small crevices of steep and horizontal rocks 1-2 m above river, partly shaded by deciduous trees, 45 m, by Shimna River, Tollymore Forest Park, J345323, D.T. Holyoak 02-931, 2 Sep 2002, det. R.M. Ros (BBSUK).

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